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The Places of Zodiacal Stars for the Epoch 1900.

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Some years ago the project was formed of constructing a catalogue of zodiacal stars, from all available sources, that would serve, for a decade or so, for such purposes as the supply of sufficiently accurate places of a large number of stars liable to occultation by the Moon, and of stars suitable as Moon-culminators. This catalogue (hereinafter called the Zodiacal Catalogue) was published in its completed form in 1905, as vol. viii. part iii. of the *Astronomical Papers of the American Ephemeris and Nautical Almanac*, under the title of "Catalogue of Zodiacal Stars for the Epochs 1900 and 1920, reduced to an absolute system." As it is fairly complete to magnitude 7·0, and contains a good many stars fainter than 7·0, the catalogue, as thus described, may appear to be rather an ambitious undertaking. Accordingly, I have been glad to avail myself of the opportunity offered by the publication of the *Cape General Catalogue for* 1900 (part i. of which gives the places of 1265 of our 1607 zodiacal stars) to utilise it for the purpose of checking the general accuracy of the Zodiacal Catalogue at the initial epoch.

The Zodiacal Catalogue is reduced to the system of Newcomb's Fundamental Catalogue, and contains all the suitably placed stars in the latter (211 in number), with their places unchanged. The Cape Catalogue is also reduced to Newcomb's system, both in right ascension and in declination, and, in addition, the right ascensions are corrected for personality depending on magnitude. As the Cape places are printed without inclusion of the proper motions, I have applied, in all cases, the effects of the proper motions given in the Zodiacal Catalogue to the Cape places. Only some 50 stars in the Zodiacal Catalogue have no proper motions assigned to them.

It was decided to reject differences between the catalogues amounting to, or greater than, $0^{s}\cdot2$ in right ascension and $3''$ in declination. The adoption of this criterion resulted in the exclusion of 8 right ascensions and 3 declinations of the Zodiacal Catalogue from the comparison. No Newcomb star has been excluded. A case of discordance in the right ascension of β *Virginis* was traced to an error in the Cape Catalogue, where the seconds of right ascension should be $29^{s}\cdot274$, in place of $29^{s}\cdot082$.

The means of the residuals without regard to sign for three hourly groups of catalogue differences, taken at random, are then found to be $^{s}\cdot030$ and $''\cdot45$ in right ascension and declination respectively for the complete comparison, including the Newcomb stars; and $^{s}\cdot019$ and $''\cdot31$ in right ascension and declination for the Newcomb stars.

The differences between the catalogue places have been combined in groups extending over one hour of right ascension. As the stars here dealt with are all ecliptic stars, it is not possible to separate discordances depending on right ascension from those depending on

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declination. The mean declination corresponding to the middle of each hour of right ascension has accordingly been entered in Table I. This table gives the mean differences in right ascension and declination of the Zodiacal Catalogue (including the Newcomb stars) *minus* Cape in the columns headed I., and the corresponding mean differences Newcomb *minus* Cape in the columns headed II. The subscript figures are the numbers of stars occurring in each group.

As before mentioned, the Cape right ascensions are corrected for personality depending on magnitude. The effect of this is apparent in the relative values of the mean differences of the columns I. and II., under the heading $\Delta\alpha$. The mean magnitude of the stars discussed in column I. is about 6; that of the stars discussed in column II. is 4 or 4·5. As the right ascensions of stars of the fainter magnitudes have a relative correction of the negative sign applied to them in the Cape Catalogue, the difference of the means is thus accounted for. The outstanding differences occurring in column I. under $\Delta\alpha$, as well as those under $\Delta\delta$, must be ascribed to the effect of the presence of the fainter stars with proper motions of inferior accuracy to those of the stars included in the columns headed II. It will be remarked, however, that there is considerable uncertainty in the values of the individual groups in the columns headed II., arising from the comparatively small number of stars in each group.

In Table II. the same groups of differences are combined in pairs and arranged in order of declination, so as to exhibit any possible variation depending on that element. In Table III. the readings of the interpolating curves, drawn through the points representing the mean differences of Table I., are given for the beginning of each hour of right ascension, and the corresponding degree of declination on the ecliptic.

It appears from this discussion that (assuming the errors of the Cape places to be relatively insignificant) the places of the Zodiacal Catalogue for 1900 may be relied upon to within quite narrow limits for the great majority of the stars contained therein. Normally, these limits should not exceed $^{s}\cdot 1$ in right ascension and $1''\cdot 5$ in declination, even in unfavourable cases, as may be inferred from the values of the means of the residuals cited above.

But we now require the places of these stars for 1910, and must allow a slightly wider margin of error for that epoch, and, from it, up to the terminal epoch of the catalogue. The average variations from the Cape observations, with which they have been here compared, are not conspicuously more irregular, at the epoch 1900, for the fainter stars than for those occurring in Newcomb's Fundamental Catalogue.

[Tables.

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TABLE I.

α,	δ.	$\Delta\alpha$.		$\Delta\delta$.	
		I.	II.	I.	II.
h h	°	s	s	″	″
0– 1,	+ 3	$+\cdot023_{50}$	$+\cdot007_{12}$	$+\cdot22_{50}$	$+\cdot26_{12}$
1– 2,	+ 9	$+\cdot017_{48}$	$+\cdot009_{8}$	$+\cdot17_{49}$	$+\cdot20_{8}$
2– 3,	+15	$+\cdot010_{49}$	$+\cdot011_{10}$	$+\cdot09_{49}$	$-\cdot05_{10}$
3– 4,	+19	$+\cdot026_{55}$	$+\cdot009_{9}$	$-\cdot09_{56}$	$+\cdot02_{9}$
4– 5,	+22	$+\cdot012_{72}$	$+\cdot004_{12}$	$+\cdot17_{72}$	$-\cdot05_{12}$
5– 6,	+23	$+\cdot015_{61}$	$+\cdot012_{4}$	$+\cdot05_{60}$	$-\cdot07_{4}$
6– 7,	+23	$+\cdot013_{58}$	$-\cdot003_{6}$	$+\cdot28_{59}$	$+\cdot08_{6}$
7– 8,	+22	$+\cdot015_{51}$	$+\cdot012_{11}$	$+\cdot08_{51}$	$+\cdot07_{11}$
8– 9,	+19	$+\cdot009_{43}$	$+\cdot007_{10}$	$-\cdot01_{43}$	$-\cdot29_{10}$
9–10,	+15	$+\cdot019_{40}$	$-\cdot005_{10}$	$+\cdot01_{41}$	$+\cdot03_{10}$
10–11,	+ 9	$+\cdot024_{44}$	$\cdot000_{9}$	$+\cdot09_{45}$	$+\cdot01_{9}$
11–12,	+ 3	$+\cdot035_{47}$	$+\cdot008_{10}$	$+\cdot08_{47}$	$+\cdot29_{10}$
12–13,	− 3	$+\cdot043_{47}$	$+\cdot010_{5}$	$+\cdot11_{46}$	$-\cdot08_{5}$
13–14,	− 9	$+\cdot023_{48}$	$-\cdot005_{6}$	$+\cdot06_{48}$	$+\cdot03_{6}$
14–15,	−15	$+\cdot032_{47}$	$-\cdot001_{11}$	$+\cdot13_{47}$	$-\cdot11_{11}$
15–16,	−19	$+\cdot032_{55}$	$+\cdot006_{10}$	$+\cdot21_{55}$	$+\cdot11_{10}$
16–17,	−22	$+\cdot050_{61}$	$+\cdot006_{6}$	$+\cdot26_{61}$	$-\cdot02_{6}$
17–18,	−23	$+\cdot037_{56}$	$-\cdot017_{7}$	$+\cdot05_{57}$	$-\cdot13_{7}$
18–19,	−23	$+\cdot029_{62}$	$-\cdot004_{7}$	$+\cdot09_{62}$	$-\cdot09_{7}$
19–20,	−22	$+\cdot033_{59}$	$+\cdot006_{10}$	$+\cdot10_{60}$	$+\cdot07_{10}$
20–21,	−19	$+\cdot032_{48}$	$+\cdot008_{8}$	$+\cdot14_{47}$	$+\cdot08_{8}$
21–22,	−15	$+\cdot015_{53}$	$-\cdot010_{10}$	$-\cdot09_{53}$	$-\cdot16_{10}$
22–23,	− 9	$+\cdot019_{49}$	$-\cdot002_{7}$	$+\cdot09_{50}$	$-\cdot12_{7}$
23–24,	− 3	$+\cdot033_{54}$	$+\cdot008_{13}$	$+\cdot14_{54}$	$+\cdot11_{13}$
Means		$+\cdot0250_{1257}$	$+\cdot0034_{211}$	$+\cdot103_{1262}$	$+\cdot017_{211}$

TABLE II.

δ.	$\Delta\alpha$.		$\Delta\delta$.	
	I.	II.	I.	II.
°	s	s	″	″
+23	$+\cdot014_{119}$	$+\cdot005_{10}$	$+\cdot17_{119}$	$+\cdot01_{10}$
+22	$+\cdot014_{123}$	$+\cdot008_{23}$	$+\cdot13_{123}$	$+\cdot02_{23}$
+19	$+\cdot018_{98}$	$+\cdot008_{19}$	$-\cdot05_{99}$	$-\cdot14_{19}$
+15	$+\cdot015_{89}$	$+\cdot003_{20}$	$+\cdot05_{90}$	$-\cdot01_{20}$
+ 9	$+\cdot021_{92}$	$+\cdot005_{17}$	$+\cdot13_{94}$	$+\cdot11_{17}$
+ 3	$+\cdot029_{97}$	$+\cdot008_{22}$	$+\cdot15_{97}$	$+\cdot28_{22}$
− 3	$+\cdot038_{101}$	$+\cdot009_{18}$	$+\cdot13_{100}$	$+\cdot02_{18}$
− 9	$+\cdot022_{97}$	$-\cdot004_{13}$	$+\cdot08_{98}$	$-\cdot05_{13}$
−15	$+\cdot024_{100}$	$-\cdot006_{21}$	$+\cdot02_{100}$	$-\cdot14_{21}$
−19	$+\cdot032_{103}$	$+\cdot007_{18}$	$+\cdot18_{102}$	$+\cdot10_{18}$
−22	$+\cdot042_{120}$	$+\cdot006_{16}$	$+\cdot18_{121}$	$+\cdot03_{16}$
−23	$+\cdot033_{118}$	$-\cdot011_{14}$	$+\cdot07_{119}$	$-\cdot11_{14}$

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TABLE III.

α,	δ.	Δα. I.	Δα. II.	Δδ. I.	Δδ. II.
h	°	s	s	″	″
0,	0	+·026	+·008	+·17	+·13
1,	+ 6	+·020	+·007	+·18	+·18
2,	+12	+·016	+·010	+·10	+·08
3,	+17	+·018	+·010	+·03	−·01
4,	+21	+·018	+·007	+·04	−·04
5,	+23	+·016	+·006	+·11	−·05
6,	+23	+·016	+·004	+·16	·00
7,	+23	+·016	+·004	+·14	+·01
8,	+21	+·015	+·006	+·06	−·07
9,	+17	+·013	+·002	·00	−·10
10,	+12	+·019	−·001	+·02	·00
11,	+ 6	+·028	+·004	+·08	+·12
12,	+ 0	+·036	+·009	+·10	+·10
13,	− 6	+·033	+·001	+·10	·00
14,	−12	+·030	·000	+·10	−·03
15,	−17	+·033	·000	+·18	·00
16,	−21	+·039	+·002	+·22	+·02
17,	−23	+·042	−·003	+·17	−·07
18,	−23	+·037	−·008	+·10	−·08
19,	−23	+·032	−·001	+·09	−·02
20,	−21	+·030	+·005	+·09	+·02
21,	−17	+·023	+·001	+·03	−·01
22,	−12	+·020	−·003	+·02	−·10
23,	− 6	+·024	+·002	+·09	−·02

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Micrometrical Measures of Double Stars (*Fourth Series*). By the Rev. T. E. Espin.

The stars measured in 1906 have been mainly those of *h*. In the list of these measures which is here given an asterisk against the number of the star denotes that the object observed is not exactly in the place given by *h*, and the difference is then given in the notes. The following stars I have not so far succeeded in identifying:—

		h m s		° ′	
h 5455	*h*'s place	2 49·14	N.P.D.	58·10 (1830)	1906 Nov. 13
h 339		3 49·15		58·10	1906 Nov. 30
h 340		3 56· 7		58· 0	1906 Nov. 30
h 2593		11 51·54		49·10	1906 April 10, 21
h 2670		13 32·50		56·16	1906 April 9, 10
h 995		23 49·26		62·17	1906 Oct. 13, 16

h.	R.A. 1900.	Decl. 1900.	P.	D.	Mags.	Date. 1900+.	Nights.
	h m	° ′	°	″			
5450	0 6·7	+35 35	232·6	4·75	9·1, 13·0	6·87	2
622	0 20·6	+34 14	131·3	18·22	9·0, 9·0	4·78	2
1032	0 26·7	+28 58	246·3	12·29	8·3, 9·0	6·80	2
625	0 30·4	+39 43	282·9	14·38	8·9, 14·0	6·71	2
629	0 50·1	+34 1	69·3	10·38	8·5, 11·5	6·86	2 BC
			74·3	71·26	A= 8·5	6·86	2 AB
631	1 59·5	+27 27	156·9	21·92	8·8, 11·0	6·90	2
636	1 8·8	+30 0	287·5	20·57	7·7, 11·0	6·84	3
1078	1 18·9	+27 3	89·8	15·18	8·5, 11·5	6·87	2 AB
			89·7	28·34	C= 10·0	6·87	2 AC
653	2 27·6	+30 58	40·9	22·99	7·8, 11·7	6·85	2
328	2 35·9	+36 3	245·5	13·07	9·5, 11·0	6·47	2
329	2 47·9	+31 18	106·0	35·41	8·0, 13·5	6·86	1
336	3 36·4	+32 37	316·2	31·68	8·0, 11·0	6·92	2 (Σ 432 rej.)
670	3 56·4	+31 53	226·8	10·50	9·5, 9·5	6·92	2
349	4 41·1	+34 35	85·6	9·87	9·1, 9·5	4·98	2
350	4 44·6	+34 37	308·1	5·50	10·7, 10·7	6·06	2
3265	5 1·3	+36 55	137·0	14·63	9·0, 9·0	6·13	2
3266	5 1·5	+36 52	61·7	8·05	9·0, 10·5	6·13	2
3272	5 13·2	+39 14	342·9	18·86	7·7, 13·0	6·09	2 AB
			296·4	27·31	C= 13·3	6·11	3 AC
			42·5	32·69	D= 11·5	6·13	2 AD
713	5 49·6	+33 15	285·0	10·10	8·9, 9·0	6·92	2
380	6 2·8	+34 29	21·8	18·67	9·0, 9·0	6·09	4
3282	6 20·8	+38 10	313·7	15·89	9·0, 12·2	6·04	2
3284	6 39·8	+36 17	84·8	5·42	10·2, 11·2	6·09	2